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54 Name of Invention: Waterproof sheeting

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72 Name of Inventor: Shirai Shigeru
Fujimori Industries, Ltd., 1-4-16 Mabata-cho, Nihombashi, Chuo-ku, Tokyo, Japan

71 Applicant: Fujimori Industries, Ltd., 1-4-16 Mabata-cho, Nihombashi, Chuo-ku, Tokyo, Japan

74 Patent Attorney: Kojima Takashi

Specification

1) Name of Invention

Waterproof sheet

2) Claims

1. A waterproof sheet, consisting of a permeable sheet totally or partially attached to one side of an impermeable sheet, so that the sides of the two sheets are separable, with impermeable reinforcing sheeting attached to the two sides where the permeable sheet and impermeable sheet are unattached.

3) Detailed Explanation of Invention

[Field of Industrial Utility]

This invention pertains to waterproof sheeting used in tunnels and other waterproofing installations.

[Prior Art]

The technique has long been known of using completely covering one side of an impermeable sheet with woven or unwoven fabric or another type of permeable sheeting for use as waterproof sheeting in tunnels or other waterproofing installations. However, in this type of waterproof sheeting, when the permeable sheet is fixed all the way to the impermeable sheet attachment points, it is difficult to attach another waterproof sheet so that it is sealed completely enough at the attachment points to prevent water infiltration at the attachments. Accordingly, as shown in Fig. 4, it has been proposed (in New Utility Models S62-35760 and 63-2502) to overlay the impermeable sheet a with permeable sheet b but not to fix permeable sheet b to attachment point c on impermeable sheet a, and instead to layer the two sheets unattached.

This waterproof sheet d, as shown in Fig. 5, has attachment point c on impermeable sheet a aligned with attachment point c' on the impermeable sheet a' of another waterproof sheet d'. This alignment point e is heat welded to attach waterproof sheets d and d' to one another.

[Problem the Invention Is to Solve]

Nevertheless, the attachment method for these waterproof sheets d and d' allows runoff from substrate or primary lining concrete side e to flow through permeable sheets b and b' to attachment point (alignment point) f directly underneath and to collect there. The weight and pressure of a large

volume of percolate water can damage attachment point f. The problem is especially likely to occur at spots with the most percolate water.

Taking note of the above-mentioned circumstance, this invention aims to provide a waterproof sheet that maintains functionality while affording an easy and secure means of attachment, preventing the attachment point from being [illegible] by percolate water pressure, eliminating the risk of damage to the attachment point even when used in locations with substantial water runoff, and preventing infiltration at the attachment point.

[Methods Used to Solve the Problem]

In order to achieve the goal stated above, the permeable sheet is totally or partially attached to the ends of the impermeable sheet so that the sides of the two sheets are separable, with impermeable reinforcing sheeting attached to the two sides where the permeable sheet and impermeable sheet are unattached.

To facilitate this, it is optimal for the two sides of said impermeable sheet (free sides) to be formed longer than the two sides of the permeable sheet.

The impermeable sheet and the reinforcing sheet can be formed from polyethylene, polypropylene, polyvinyl chloride, ethylene vinyl acetate copolymer or another impermeable resin material. In addition, the permeable sheet can be formed from woven or unwoven fabric. The reinforcing sheet should be thinner than the impermeable sheet (for instance, 0.4 mm for the former, 0.8 mm for the latter).

[Function]

The waterproof sheet that is the subject of this invention may be used in tunnel waterproofing and other similar applications. In the case of tunnels, the sheeting is applied so that the impermeable sheets are opposite to the substrate or primary lining concrete, with the sheeting held in place in the substrate or concrete using concrete pins or other similar fixing material. When connecting waterproof sheets together, the atttachment point where the reinforcing sheet is placed on one waterproof sheet is placed overlapping the attachment point of reinforcing sheet of the other waterproof sheet. Fixing material is applied to the seam to attach it to the earth or the primary layer concrete. After this, the sides of the impermeable sheets (the free sides) of the two waterproof sheets are aligned overlapping, and this area is then heat welded.

As a result, by using this mode of attachment, said seam is reinforced by multiple layering of the impermeable reinforcing sheeting. Sheets are placed over the substrate or concrete layered as follows: the permeable sheet of the

first waterproof sheet, then the impermeable sheet of the first waterproof sheet, then the permeable sheet of the second waterproof sheet, then the impermeable sheet of the second waterproof sheet. Any percolate water from the earth or the concrete is stopped from flowing down onto said attachment point (aligned overlapping area) by the impermeable reinforcing sheet, which prevents said attachment point from being [illegible] by percolate water pressure. Thus, there is no risk of damage to the attachment point, as the two waterproof sheets form a waterproof attachment.

The technique is already known for taking a waterproof sheet formed from an impermeable sheet layered over a permeable sheet and and heat fusing one side using an impermeable synthetic resin connection piece at a specified distance from the connection point of that side, leaving the other side free (New Utility Model 63-30578). However, this invention uses a reinforcing sheet that is easier to securely attach to the permeable sheet by using heat fusing or an adhesive material, much the way that weather stripping can be easily and securely attached. As a result, infiltration from the seam is extremely small, offering a significant functional benefit, along with a cost advantage compared to using a thick impermeable sheet.

[Example Implementation]

The following section describes an example implementation of this invention, with reference to Fig. 1 and Fig. 2.

Fig. 1 shows one example implementation of this invention, waterproof sheet 1. This waterproof sheet 1 consists of impermeable sheet 2, covered completely by permeable sheet 3, with the two sides of both sheets 2 and 3 left open and unattached, but otherwise with the two sheets layered and totally or partially attached. Sides 4a and 4b of said permeable sheet 3, which are unattached to impermeable sheet 2, are firmly and completely attached by impermeable reinforcing sheets 5a and 5b, respectively. Sides 6a and 6b (the free sides) of impermeable sheet 2 are formed long enough to extend beyond the sides of permeable sheet 3.

When said waterproof sheet 1 is used for tunnel waterproofing, waterproof sheet 1 is applied over primary lining concrete 8, which covers substrate 7, so that permeable sheet 3 is oriented toward primary lining concrete 8, with waterproof sheet 1 fixed in place using concrete pins or other fixing material. Although not shown in the figure, after waterproof sheet 1 is applied, it is covered with a secondary lining concrete layer. Consequently, percolate water from the primary lining concrete is prevented from infiltrating to the secondary lining concrete by waterproof sheet 1.

In this instance, waterproof sheet 1 is applied while being sequentially connected to another waterproof sheet 1'. When doing so, reinforcing sheet

5a on waterproof sheet 1 is aligned overlapping reinforcing sheet 5b on waterproof sheet 1'. This seam 9 is fixed to primary concrete layer 8 using concrete pins or other fixing material 10. Next, free side 6a of impermeable sheet 1 on waterproof sheet 1 is aligned with free side 6b on waterproof sheet 1', and the alignment point is heat welded.

Consequently, by using said mode of connection, the mutual connection between between waterproof sheets 1 and 1' can be made easily, securely, and in a manner that is functionally sound. In addition, said seam 9 is formed by applying sheets in the following sequence, moving outward from the primary lining concrete layer: permeable sheet 3 of waterproof sheet 1, water impermeable reinforcing sheet 5a, permeable sheet 3' of waterproof sheet 1', impermeable sheet 5b'. The contact point (alignment point) 10 on seam 9 is protected by impermeable reinforcing sheets 2 and 2', cutting off direct contact with primary lining concrete 8 and preventing infiltration of percolate water downward to connection point 11 from primary lining 8. As a result, contact point 11 is not [illegible] by percolate water pressure, avoiding damage to contact point 11 from percolate water pressure. In this instance, percolate water from the primary lining concrete can permeate permeable sheet 3' between said impermeable sheets 2 and 2' and seep to contact point 11. However, the volume of seepage is tiny, and the percolate water pressure is greatly reduced, compared to the past configuration shown in Fig. 4, where percolate water infiltration reaches the contact point. In particular, since reinforcing sheets 5a and 5b are firmly and completely attached to permeable sheet 3 using heat welding or an adhesive, any air pockets on the sides of permeable sheet 3 are filled up and closed off by the heat welding or adhesive. This reduces water traversal and, as a consequence, dramatically reduces water infiltration from the seam.

In said example implementation, the two sides 6a and 6a' are mutually aligned in the interconnection between waterproof sheets. However the connection mode is not limited to this. For example, as shown in Fig. 3, the two sides 6a and 6b can be overlapped and the seam heat welded (at heat seal point H in the figure). Other altered configurations may variously be employed without departing from the substance of this invention.

[Benefits of the Invention]

The waterproof sheet that is the subject of this invention makes it possible to connect waterproof sheets easily and securely, and with a high degree of functionality. This prevents [illegible] to the connection resulting from percolate water pressure, and eliminates the risk of damage to the connection due to percolate water pressure. Consequently, the waterproof sheet that is the subject of this invention can be used effectively and with great practical benefit even in locations with substantial volumes of percolate water.

Fig. 1 shows a sectional view of an example impl mentation of the invention. Fig. 2 shows a partial abbreviated sectional view of an attachment mode used with this waterproof sheet. Fig. 3 shows a partial abbreviated sectional view of another attachment mode used with this waterproof sheet. Fig. 4 shows a sectional view of an existing waterproof sheet. Fig. 5 shows a partial sectional view of a connection mode used with this existing waterproof sheet.

1, 1'	Waterproof sheet
2, 2'	Impermeable sheet
3, 3'	Permeable sheet
5a, 5b, 5b'	Impermeable reinforcing sheet

Applicant: Fujimori Industries, Ltd.
Patent Attorney: Kojima Takashi (and one other)